## REMARKS/ARGUMENTS

In view of the foregoing amendments and the following remarks, the applicants respectfully submit that the pending claims are not rendered obvious under 35 U.S.C. § 103. Accordingly, it is believed that this application is in condition for allowance. **If, however, the Examiner believes that there are any unresolved issues, or believes that some or all of the claims are not in condition for allowance, the applicants respectfully request that the Examiner contact the undersigned to schedule a telephone Examiner Interview before any further actions on the merits.**

The applicants will now address each of the issues raised in the outstanding Office Action.

### Objections

Claims 2 and 17 stand objected to as being dependent upon the rejected base claims, but would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims. Since claims 1 and 16 are allowable for the reasons discussed below, claims 2 and 17 have been maintained in their original form at this time.

### Rejections under 35 U.S.C. § 112

Claim 1 stands rejected under 35 U.S.C. § 112, ¶ 2 as including a phrase lacking proper antecedent basis. Claim 1 has been amended based on the Examiner's helpful comment.

**Rejections under 35 U.S.C. § 103**

Claims 1, 3-16 and 18-37 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,747,971 ("the Hughes patent") in view of U.S. Patent No. 6,477,169 ("the Angle patent"). The applicants respectfully request that the Examiner reconsider and withdraw this ground of rejection in view of the following.

Each of the independent claims is not rendered obvious by the Hughes and Angle patents, either taken alone or in combination, because these patents neither teach, nor suggest, one or more of (i) in a switch having k x n output ports, input modules, each of the input modules having k groups of n virtual output queues ("VOQs"); (ii) two-stage matching performed at each input module; and (iii) the particulars of the recited master-slave arbitration scheme. Each of these patentable features is discussed below.

***In a switch having k x n output ports, input modules, each of the input modules having k groups of n virtual output queues***

Each of independent claims 1, 10, 16 and 28 recite input modules (of a switch having k x n output ports) that each have k groups of n VOQs. The Hughes and Angle patents, either taken alone or in combination, neither teach, nor suggest, this feature.

The Examiner contends that the Hughes patent teaches k input modules, each having n input ports, n x k virtual output queues, and m outgoing links; n x k virtual output

queues of each input module are grouped into k groups of n virtual output queues. The applicants respectfully disagree.

Referring to Figure 3 of the Hughes patent, it is clear that the Hughes patent does not teach k input modules, each having n input ports, n x k VOQs, and m outgoing links, where n x k VOQs of each input module are grouped into k groups of n VOQs. Rather, the Hughes patent merely teaches n input modules (Fig.3, 304a-304n) each having n+1 VOQs (312a-312n plus 313), not n x k VOQs as claimed. Further, the Hughes patent does not teach that n x k VOQs of each input module are grouped into k groups of n VOQs. Indeed, the Hughes patent has no groups of VOQs, but simply n+1 virtual output queues for each input port (Fig.3, 312a-312n plus 313).

Therefore the comprised combination of components taught by the present invention and Hughes are substantially different. The Angle patent does not compensate for this deficiency of the Hughes patent. In particular, the Angle patent simply discusses a method and apparatus for scheduling multicast and unicast data in an input-queued network device. The Angle patent discusses a method where input ports are matched with output ports for the dispatch of either multicast or unicast cells. The Angle patent uses a fabric configuration manager 110 (See Figures 1 and 2.) which interact with both the input and output ports of a networking device and includes a multicast scheduler and a unicast scheduler for scheduling the dispatch of multicast and unicast cells respectively.

During multicast scheduling, the input ports may send requests (shown as solid line arrows from input

ports to output ports in Figure 4) to various output ports, wherein the output ports accumulate request information from the input ports and form request vectors (425-428) indicating from which input ports they have received requests. (See Figure 4.) Using the request vectors (425-428), the global round robin counter (GRRC 450) and the input and output unavailability indicators (405-408 and 415-418 respectively), the Angle patent may use a series of output grant arbiters 550 (See Figure 5.) to select and send grants back to the winning input ports, thereby establishing input-output matches. The grants are depicted as dashed line arrows from output to input ports. (See, e.g., Figure 4, Cols. 7-9; and Col. 10, lines 1-46.)

During unicast scheduling, a similar method as described above is employed with the exception that now the input ports may form grant vectors 735 (See Figure 7B.) indicating by which output port a grant has been received since now an input port may receive grants by more than one output ports, while the input ports are allowed to send a cell to only one output port during matching. During unicast scheduling, the Angle patent may use both output grant arbiters at the output ports and input accept arbiters at the input ports to arrange a match between an input port and an output port. (See, e.g., Figures 6-8; Col. 10, lines 46-67; Cols. 11-14; and Col. 15, lines 1-59.)

From the above, it can be appreciated that the Angle patent is matching input ports with output ports for cell dispatching, not non-empty VOQs with input module outgoing links as claimed in the present invention. The structure of the Angle patent is substantially different

from that of the present invention. The Angle patent mentions nothing about k groups of n VOQs included in input module, nor does Angle's invention include arbiters for every VOQ within an input module.

Thus, independent claims 1, 10, 16 and 28 are not rendered obvious by the Hughes and Angle patents for at least the foregoing reason. Since claims 3-9 depend, either directly or indirectly, from claim 1, since claims 11-15 depend from claim 10, since claims 18-27 depend, either directly or indirectly, from claim 16, and since claims 29-37 depend, either directly or indirectly, from claim 28, these claims are similarly not rendered obvious by the Hughes and Angle patents.

***Two-stage matching performed at each input module***

Each of independent claims 1, 10, 16 and 28 recite input modules that perform a two stage matching. The Hughes patent does not teach a method for matching a non-empty virtual output queue (VOQ) of the input module with an outgoing link in the input module, and further matching the outgoing link of the input module with an outgoing link of one of the central modules. The Hughes patent merely teaches a method where a request controller 314 (which the Examiner contends is an arbiter) constructs a switch frame (See 315a-h of Figure 3.), where each switch frame contains service requests for selected cells queued in the ingress port 304a (input module). Frames 315a-h are sent to the switch planes 309a-h (central modules). (See col.6, lines 64-67; col.7, lines 1-4; and Figure 3.)

The Examiner contends that, essentially, the Hughes patent is matching a non-empty VOQ 312a-312n and 313 with a switch plane 309a-h (central module), apparently by assigning cells to a particular row of a switch frame. However, since each row of a switch frame can include requests and/or cells from more than one VOQ, it does not match the outgoing link with an outgoing link of one of the central modules.

Nothing in the Angle patent compensates for this deficiency of the Hughes patent with respect to the independent claims. The Angle patent does not have input module outgoing link arbiters for matching a non-empty VOQ with an outgoing link within the input module. Also the Angle patent needs two different apparatus and methods for scheduling multicast and unicast cells. The Angle patent merely uses a system where each input port has an input accept arbiter and every output port has an output grant arbiter to perform matches between input ports and output ports. (See, e.g., Figure 8.)

Thus, independent claims 1, 10, 16 and 28 are not rendered obvious by the Hughes and Angle patents for at least the foregoing reason. Since claims 3-9 depend, either directly or indirectly, from claim 1, since claims 11-15 depend from claim 10, since claims 18-27 depend, either directly or indirectly, from claim 16, and since claims 29-37 depend, either directly or indirectly, from claim 28, these claims are similarly not rendered obvious by the Hughes and Angle patents.

***Particulars of the recited master-slave arbitration scheme***

Each of independent claims 10, 16 and 28 recite particulars of a master-slave arbitration scheme. The Hughes patent does not teach means for broadcasting a request for the non-empty VOQ to a master arbiter and slave arbiters, each of the master arbiters and slave arbiters being associated with one of the outgoing links of the input module, for each of the outgoing links of the input module. The Hughes patent merely discusses a method where a multicast cell may be queued in a multicast queue in the ingress port (input module) and one of the frames may be sent to each of the switch planes per cycle, where one frame exists per queued multicast cell. (See col. 3, lines 66-67; and col. 4, lines 1-2.) Furthermore, the Hughes patent discusses a method where a request controller 314 (purportedly an arbiter) simply selects from the VOQs which cells are to request service, and then implements the service request process for the selected cells. (See col. 6, lines 41-44.)

On the other hand, according to some embodiments consistent with the present invention, a method is taught for non-empty VOQs to broadcast requests to slave arbiters and master arbiter for each of the outgoing links in the input module. Specifically, each VOQ has an arbiter which may broadcasts a request to each of the slave and master arbiters in the input module. A series of requests and grants takes place within the input module until a non-empty VOQ winning arbitration may be matched with an outgoing link. (See page 50, lines

14-32; page 51; page 52, lines 1-5; and Figures 19a-19c of the present application.) Again as mentioned earlier, the Examiner's assertions regarding the Hughes patent pertain to the matching and interaction taking place between the queued cells in the input module and the central module, not between the queued cells and outgoing links within the input module.

From the foregoing, it is also apparent that the two inventions differ in structure. Specifically, an embodiment consistent with the present invention has arbiters in every VOQ and master arbiters along with groups of slave arbiters for every outgoing link within each input port for establishing a match between a non-empty VOQ and an outgoing link (See, e.g., Figures 19a-19f.), whereas the Hughes patent only has a single arbiter (See Figure 3, element 314.) in each input module for selecting non-empty VOQs and processing requests between the input module and central module. The Hughes patent does not have an arbiter for each VOQ for broadcasting a request, nor does it have arbiters for each of the outgoing links of the input module for selecting a non-empty VOQ that broadcast a request. Hence the two inventions are fundamentally different.

Moreover, the Hughes patent neither teaches, nor suggests (a) "slave arbiters, each of the slave arbiters being associated with one of each of the outgoing links of the input module"; or (b) "master arbiters, each of the master arbiters being associated with one of each of the outgoing links of the input module." According to one embodiment consistent with the present invention, during the first phase of dispatching queued cells stored in the VOQs, a method is taught for matching a non-empty

VOQ 125 with an outgoing link 130 in the input module 120. (See page 37, lines 16-29; and Figure 19a-19c of the present application.)

Examining the dispatching at a first phase of queued cells at the input module of the Hughes patent, substantial differences to the dispatching at a first phase of queued cells at the input module of the present invention are found. Specifically, the Hughes patent uses a method wherein a request controller 314 (arbiter) is responsible for selecting queued cells from the VOQs and issuing service requests. The request controller 314 constructs a switch frame 315a-h that is sent to each switch plane 309a-h. Each switch frame 315 contains a number of service requests for selected cells in the input module. (See, e.g., col. 6, lines 64-67, and Figure 3 of the Hughes patent.) The Hughes patent uses the request controller 314 to map the service requests into the switch frames. According to Figure 3 of the Hughes patent, there are 14 ingress/egress ports 304a-n/306a-n, 14 unicast queues 312a-n, one multicast queue 313, and 8 switch frames 315a-h. Each switch frame 315 may map up to 14 service requests for queued cells to their proper ingress port 306. (See, e.g., Figures 3 and 5; and col. 9, lines 19-63 of the Hughes patent.) The switch frames 315 have a request type 506 indicating whether it is a multicast or unicast frame and use a two-bit field to represent the four different service request sates (primary request (10), secondary request (01), no cell requesting service (00), primary request with speedup (11)). (See, e.g., col. 9, lines 64-67; col. 10, lines 1-23; col. 11, lines 65-67; and Figure 5 of the Hughes patent.) Generally, cells at the head of

the line in a queue are deemed as a priority and are mapped by the request controller 314 to an initial switch frame. Thus, the initial switch frame comprises a primary service request. The remaining cells in the queue (if any) are non-priority cells (secondary requests) and are mapped sequentially in a round robin fashion across the following switch frames, one secondary request per switch frame. (See, e.g., col. 10, lines 32-67; col. 11, lines 1-14; and Figure 5 of the Hughes patent.)

On the other hand, an exemplary input module 120' of the present invention has VOQs 1910a-d which include VOQ arbiters 1915a-d for broadcasting service requests to all link controllers 1920a-b which may be associated with master arbiters 1925a-b and a number of slave arbiters 1940a-d. Specifically, a non-empty VOQ 1920 may broadcast a request to each of the slave arbiters 1940 of a VOQ group (to which the VOQ 1910 belongs). A VOQ group, having at least one non-empty VOQ, may broadcast a request to each of the master arbiters 1925 (each associated with an outgoing-link) in the input module (IM) 120'. Once the slave arbiters and master arbiters receive the VOQ requests, they may reply with grants back to the selected VOQ arbiters 1915. Specifically, a master arbiter 1925 may communicate a grant message to a slave arbiter 1940 associated with the master arbiter 1925 (or, in other words, associated with the outgoing-link with which the master arbiter is associated) and belonging to the VOQ group that was selected. Outgoing-link slave arbiters 1940 may send a grant to a selected VOQ.

Next, the VOQ arbiters receiving a grant may reply with a grant back to a selected link controller 1920. At this point, a VOQ 1910, winning arbitration, may be matched with an outgoing link.

Nothing in the Angle patent compensates for this deficiency of the Hughes patent with respect to the independent claims. The Angle patent does not have input module outgoing link arbiters for matching a non-empty VOQ with an outgoing link within the input module. Also the Angle patent needs two different apparatus and methods for scheduling multicast and unicast cells. The Angle patent merely uses a system where each input port has an input accept arbiter and every output port has an output grant arbiter to perform matches between input ports and output ports. (See, e.g., Figure 8.)

Thus, independent claims 10, 16 and 28 are not rendered obvious by the Hughes and Angle patents for at least the foregoing reason. Since claims 11-15 depend from claim 10, since claims 18-27 depend, either directly or indirectly, from claim 16, and since claims 29-37 depend, either directly or indirectly, from claim 28, these claims are similarly not rendered obvious by the Hughes and Angle patents.

***Summary***

From the aforementioned, it is apparent that the Hughes patent in view of the Angle patent substantially differs from the present invention in the method and structure used in the input module for cells requesting service and the process entailed in fulfilling this service.

Moreover, it would have not been obvious to a person of ordinary skill in the art at the time the invention was made to apply Angle's multicast and unicast scheduling for a network device into Hughes' crosspoint switch with independent schedulers with the motivation being to provide a method and apparatus for scheduling the service of cells or packets buffered at input ports of a switch.

**Conclusion**

In view of the foregoing amendments and remarks, the applicants respectfully submit that the pending claims are in condition for allowance. Accordingly, the applicants request that the Examiner pass this application to issue.

Respectfully submitted,

July 8, 2005

John C. Pokotylo, Attorney
Reg. No. 36,242
Tel.: (732) 542-9070

**CERTIFICATE OF MAILING under 37 C.F.R. 1.8(a)**

I hereby certify that this correspondence is being deposited on **July 8, 2005** with the United States Postal Service as first class mail, with sufficient postage, in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

John C. Pokotylo

36,242
Reg. No.